

## Research article

## A novel method for sciatic nerve decompression: Cadaveric feasibility study with potential application to patients with piriformis syndrome

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## ABSTRACT

**Introduction:** Approaches for proximal sciatic nerve decompression use a transgluteal route, but are associated with morbidity and complications. An alternative anterior approach to the sciatic nerve was designed.

**Methods:** Five adult human cadavers (10 sides) were used. In the supine position and with lower limbs abducted, an incision was made 3-cm inferolateral to the pubic tubercle of each specimen. With blunt dissection, a muscle-splitting approach through the obturator foramen was performed through the underlying adductor muscles and deeper obturator muscles that traversed the obturator foramen. Within the pelvis, a laparoscope was inserted in the surgical corridor, which was extraperitoneal. The obturator neurovascular bundle was identified medially and followed posterolaterally toward the greater sciatic foramen. The sciatic nerve was identified. The piriformis muscle was identified as it exited the greater sciatic foramen. Microscissors were inserted and under visualization with the laparoscope, the piriformis muscle was transected near the spine.

**Results:** The piriformis was well visualized and transected. The muscle was best visualized inferolateral to the sciatic nerve. No gross damage to the sciatic nerve or surrounding neurovascular structures occurred. Mean distance from the superomedial edge of the obturator foramen to the ischial spine was 7.2 cm for left sides and 7.3 cm for right sides.

**Conclusions:** Use of a laparoscope to approach the piriformis muscle from an anterior intrapelvic, extraperitoneal approach via the obturator foramen is feasible. Clinical use of this method is in order to demonstrate use in patients with suspected compression of the sciatic nerve by the piriformis muscle.

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## 1. Introduction

Many etiologies have been considered for sciatic nerve compression as it exits the pelvic region. The piriformis muscle has long been recognized as a causative factor in nondiscogenic sciatic nerve pain, i.e. the piriformis syndrome [1–4]. The piriformis muscle functions as a lateral rotator, a weak abductor, and hip

flexor, and also provides some postural stability during ambulation and standing. It originates from the anterior surface of the sacrum [5]. The muscle courses through the greater sciatic foramen and inserts onto the superior medial aspect of the greater trochanter [6]. The sciatic nerve originates from the ventral rami of L4 to S3 [2,7]. It also exits the pelvis via the greater sciatic foramen, along the inferior surface of the potentially compressive piriformis muscle. The development of symptoms from compression in this fibro-osseous tunnel can be divided into three categories: 1) muscle spasm secondary to irritation of the piriformis, 2) inflammatory or degenerative changes of the muscle, tendon, or fascia, and 3) degeneration or deformities affecting the bony origin or insertion of the piriformis muscle [8]. Because of this anatomic relationship, the

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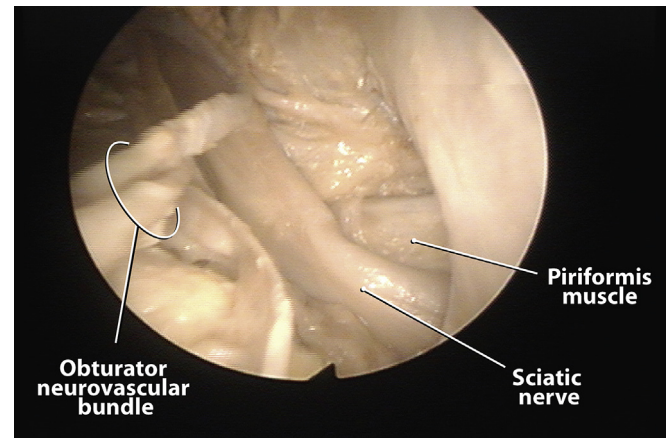
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piriformis is often bisected if sciatic nerve compression is suspected.

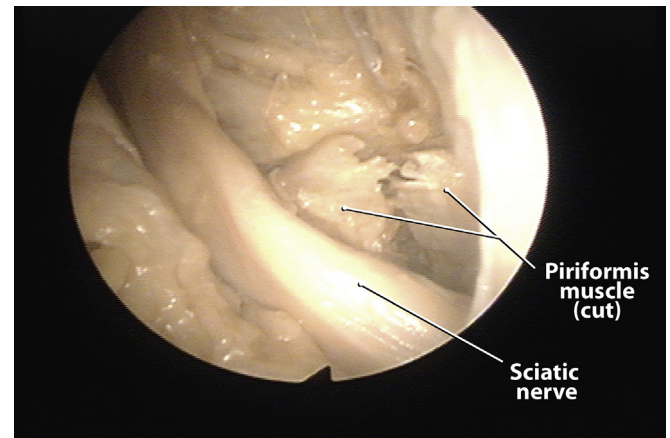
The current method for approaching sciatic nerve compression by the piriformis is through a transgluteal route. An incision is made over the greater trochanter of the femur [3]. The gluteal fascia is opened and blunt finger dissection of the gluteal muscles follows [3,8]. The piriformis muscle is then located while carefully avoiding the superior gluteal, inferior gluteal, and sciatic nerves, which are in close proximity [3]. The piriformis muscle is then transected to relieve compression of the underlying sciatic nerve. The current study aims to propose an alternative, minimally invasive approach to transect the piriformis for relief of sciatic nerve compression.

## 2. Materials and methods

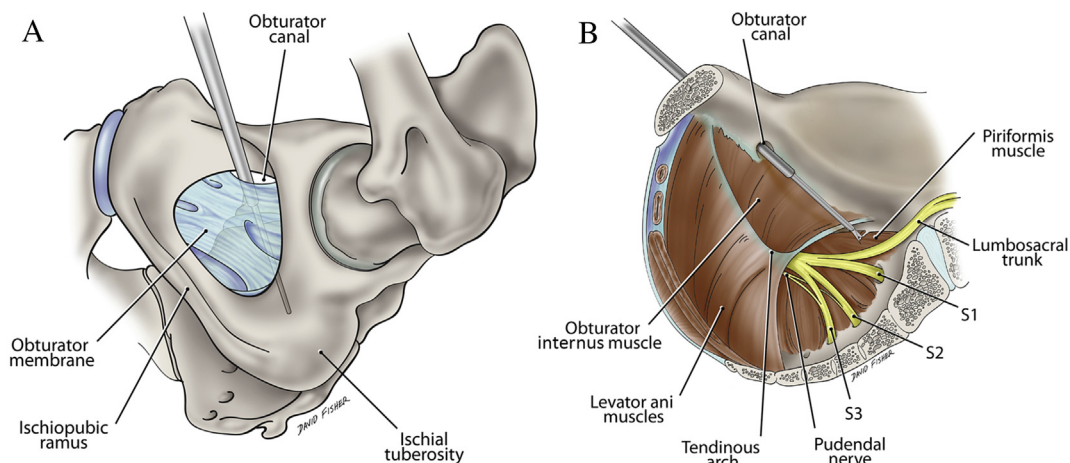
Five adult human cadavers (10 sides) with a mean age at death of 71 years (range 45–95 years) were used for the present study. Three specimens were male and two specimens were female. No gross pathology was noted in any specimen. One female specimen had undergone a hysterectomy and her ovaries were not visible. In the supine position and with the lower limbs abducted and slightly laterally rotated, a small 1-cm skin incision was made 3 cm inferolateral to the pubic tubercle of each specimen. With blunt dissection using hemostats, a muscle-splitting approach was performed through the underlying adductor muscles and deeper obturator muscles, which traversed the obturator foramen. The dissection was extended to the level of the inferior pubic ramus and circumvented this bony region while entering the obturator foramen (Fig. 1A and B). Once within the pelvis, a rigid laparoscope (Stryker Inc., Kalamazoo, MI) was inserted within the surgical corridor and advanced at 30° cephalad in the anteroposterior direction aiming toward the ischial spine. Next, the obturator neurovascular bundle was identified medially and followed posterolaterally toward the greater sciatic foramen. Once the sciatic nerve was identified within the pelvis (Fig. 2), the piriformis muscle was located as it exited the greater sciatic foramen. Next, microscissors were carefully inserted and under direct visualization with the laparoscope, the piriformis muscle was transected (Fig. 3) at the level of the ischial spine. Statistical analysis between sides and genders was performed using Statistica (Tulsa, OK) with statistical significance set at  $p < 0.05$ .



**Fig. 2.** After entry into the right sided of the pelvis of a cadaver, the endoscope is advanced toward the ischial spine and follows the obturator neurovascular bundle (9 o'clock position) posteriorly toward the sciatic nerve, which in the center of this view. In the background and at the 4 o'clock position, the piriformis is seen (compare to Fig. 3).



**Fig. 3.** Endoscopic view following transection of the piriformis muscle. The sciatic nerve is seen to the left.



**Fig. 1.** A. Schematic drawing illustrating endoscopic entry site. B. Schematic drawing and parasagittal view illustrating the advancement of the endoscope toward the piriformis and use of microscissors to transect the muscle.

### 3. Results

The intrapelvic part of the piriformis muscle was well visualized in all specimens. The muscle was best visualized inferolateral to the sciatic nerve in all specimens and at an average angle of 15° from the midline (range 10 to 25°). No grossly identifiable damage to the sciatic nerve or surrounding neurovascular structures, e.g. obturator neuromuscular bundle, was noted in any specimen. The distance from the superomedial edge of the obturator foramen to the ischial spine ranged from 6 to 8 cm (mean 7.2 cm) for left sides, and from 5 to 9 cm (mean 7.3 cm) for right sides. The differences in distances between the obturator foramen and ischial spine for male and female cadavers and between left and right sides were not statistically significant.

### 4. Discussion

The current transgluteal approach, although effective, is invasive and carries with it significant morbidity for the patient. For example, surgeons have reported postoperative discomfort during sitting among patients due to scar tissue following a transgluteal approach. To avoid that problem, some surgeons use a larger incision that is lateral and inferior, but requires some muscle transection with resultant postoperative pain, spasm and potential muscle (gluteus maximus) dysfunction. Our less invasive anterior approach eliminates scar formation in the gluteal region, uses a small puncture site, and potentially decreases recovery time as the dissection is through muscles that are not compressed during sitting postures. Such an approach could also be used to expose other pathologies of the intra-pelvic sciatic nerve such as nerve tumors.

Martin et al. [9] performed a study addressing deep gluteal pain syndrome in which an alternative endoscopic route was employed to relieve the sciatic nerve from impingement by 1) the quadratus femoris, 2) the inferior gemellus, 3) fibrovascular scar bands, and 4) the piriformis muscle. The results of their study used endoscopic entry into the peritrochanteric space, which allowed access to the deep gluteal region and thus provided a similar operative corridor when compared with that of the open transgluteal route. Their outcome indicated that the endoscopic treatment of deep gluteal syndrome was effective in relieving pain in patients with extra-articular posterior hip pain [9]. However, this method still employed a posterior approach to the gluteal region with the potential for the complications mentioned above.

Volpi et al. [7] explored the pelvic region laparoscopically to address a case of catamenial foot drop involving the sciatic nerve. The patient had a previous history of ovarian endometriomas, which were removed laparoscopically. Ten months after surgery, the patient returned complaining of right posterior leg pain, which occurred only during menses [7]. A second laparoscopy procedure was performed to evaluate the endometriosis that was infiltrating the pelvic region, and at operation, the sciatic nerve was enveloped in fibrotic tissue near the obturator internus muscle [7]. In this case, the laparoscopic approach proved to be minimally invasive and equally as effective in diagnosing and visualizing nerve involvement as opposed to a more open and invasive technique. Possover et al. [10] used laparoscopy to remove endometriosis from the sacral plexus and surrounding nerves including the sciatic nerve. The authors reported good success in their patients and advocated using such a strategy in patients where other etiologies of nerve dysfunction have been ruled out.

One concern with this approach is the fact that some patients with the clinical piriformis syndrome are found to have compression by structures other than the actual piriformis muscle, including fascial bands or vascular structures that are distal to the

sciatic notch. The approach described herein could address these pathologies if they were near the proximal part of the piriformis muscle but more lateral disease i.e. near the insertion onto the femur may not be easily reached with our anterior intrapelvis approach. However, some patients have syndromes that may involve entrapment of the obturator nerve, and this approach would likely treat that condition as well. Another concern is that although no physical evidence of injury to the obturator nerve was seen on inspection, this does not rule out the possibility that the endoscopic instrument could injure that nerve during the procedures, something that would have to be carefully avoided in a living patient. This lateral approach would avoid the midline urinary bladder or uterus. Larger vessels e.g., internal iliac would be out of the trajectory of the approach. Smaller tributaries might be injured but would be dealt with as in other standard laparoscopic approaches. Contraindications to our method would include prior pelvic surgery, pregnancy, or intrapelvic masses.

### 5. Conclusions

Based on our study, the use of a laparoscope to approach the piriformis from an anterior approach via the obturator foramen is feasible. The approach is more direct, avoids large incisions with take down of muscle, and obviates approaches that enter the peritoneum. Clinical use of this method is now in order to demonstrate the utility of this technique.

### Ethical considerations

All specimens were handled in accordance to the laws and regulations of the country in which the study was performed. The specimens used for this research are protected under the IRB approval (06014) as issued by St. George's University.

### Funding

None.

### Conflicts of interest

None.

### Statement regarding the importance of this article

Current approaches for proximal sciatic nerve decompression use a transgluteal route, but they may be associated with a certain degree of morbidity and postoperative complications. To address such issues, the authors designed an alternative anterior approach to the sciatic nerve.

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